The Arizona Long Range Strategic Educational Techology Plan, adopted on April 27, 2009, has four goals. Goal 4 addresses infrastructure which includes broadband. Here is an exerpt from the Tech Plan:

Goal 4: Infrastructure

To accomplish this, the infrastructure should provide:

-secure and reliable anytime/anywhere access to a variety of current and emerging technologies.
-just-in-time assistance to support the use of technology for administration, teaching and learning.
-policies and procedures that ensure equitable access to all users.

Trends in Infrastructure Development and Support

When examining trends in infrastructure there are a variety of organizations and reports that provide information on trends, resources, and personnel necessary to support the use of technology in schools today. Two of the most influential reports are the America"s Digital Schools (ADS) report for 2008 and the Horizon 2009 K-12 Edition Report.

America's Digital Schools

The 2008 Americaâ€™s Digital Schools (ADS) report details several trends to watchâhen considering the technology infrastructure needed in today's schools.

Large Scale 1:1 Implementations
The report finds that 1:1 implementations are now relatively widespread in education. With 27% of districts reporting their involvement in 1:1 computing, this trend has moved into the mainstream. Arizona reflects this national trend, with almost 23% of school districts reporting that they have 1:1 implementations in place. Sustained funding and adequate support staff for this level of technology are important items that must be considered as schools move forward with 1:1 projects.

Learning Management Systems Go Mainstream
The percentage of school districts using a Learning Management System (LMS) has climbed to almost 50%, with another 19% indicating plans for future implementation. Arizona trails slightly in regards to this trend with 40% of districts reporting use of an LMS. Almost half of Arizona schools with LMSs host them on in-house servers. As more districts take advantage of this learning tool, schools need to ensure they have the support staff to maintain the reliability of these systems.

Online Assessment Is Replacing the No. 2 Pencil

In 2007, there was widespread use of online assessment in schools for the first time, with 30.4% of districts reporting their use. The 77-year dominance of No. 2 pencils and bubble paper tests appear to be coming to an end. Providing a sufficient number of computers or other hardware to take online assessments will increasingly move schools towards 1:1 or near 1:1 student to computer ratios, which increases the funding and support concerns associated with these type of projects.

The Student Computing Mobility Race Accelerates

The use of student-owned handheld devices is on the rise. The report saw use of traditional PDAs with a rise in the number of Smart phones and web-enabled devices. The use of Mp3 players such as the Apple iPod has also exploded. Technology staffs are increasingly challenged to adequately plan infrastructure and policies to accommodate the expanding use of these devices both inside and outside of school networks.

Interactive Whiteboards

Interactive whiteboards (IWBs) have moved well beyond the initial adoption stages and are increasingly viewed as standard equipment in schools. Teachers quickly come to find them essential. There has also been increased integration of IWBs with other classroom technologies, including student response units and mobile computing devices.

The findings of the ADS report are confirmed in the 2007 Speak Up Survey where teachers and students were asked to design their ultimate school. It is interesting to note that 1:1 computing received the highest percentage with interactive whiteboards a close second.

Broadband Crisis

The vast majority of schools (over 95%) in Arizona are connected with local networks and, in districts with multiple locations, with networks that connect multiple school locations. Likewise, schools and districts report that over 98% of schools have access to the Internet. This represents significant progress in getting schools connected both internally and to the Internet. Additional data elements demonstrate, however, that there is more work to be done in increasing the capacity of those connections between schools in a district and to the Internet. The State Educational Technology Directors Association (SETDA) recently released a broadband whitepaper, High-Speed Broadband Access for All Kids: Breaking Through the Barriers, which provides a breakdown of bandwidth requirements for different educational activities. SETDA analyzed that data and produced a recommendation for increasing bandwidth capacity at schools to:

In a technology-rich learning environment for the next 2-3 years, SETDA recommends:
-An external Internet connection to the Internet Service Provider of at least 10 Mbps per 1,000 students/staff
-Internal wide-area network connections from the district to each school and between schools of at least 100 Mbps per 1,000 students/staff
In a technology-rich learning environment for the next 5-7 years, SETDA recommends:
-An external Internet connection to the Internet Service Provider of at least 100 Mbps per 1,000 students/staff
-Internal wide area network connections from the district to each school and between schools of at least 1 Gbps per 1,000 students/staff
High-Speed Broadband Access for All Kids: Breaking Through the Barriers, p 2.

Perhaps the most important element from SETDAâ€™s broadband report is their recognition that bandwidth capacity has to be considered in terms of the number of students using the networks or Internet. Currently, over 50% of Arizonaâ€™s schools have a 10 Mb or less connection to the Internet. Of the remaining 50% with 10 MB or greater connections, the number of students in the district would indicate that those connections per student are also far below the recommended levels of broadband. It is essential that schoolsâ€™ broadband infrastructure have the capacity to take advantage of the dynamic, digital resources available for teaching students, to deliver and track student assessments, and to enable classrooms to connect with learning opportunities around the globe.

Horizon 2009 K-12 Report

Horizon 2009 K-12 Report - Technologies of Interest
In making its recommendations, the ETAC also considered many technologies and their potential impact on student learning and the infrastructure required to support it. Of particular interest were the six technologies identified by the Horizon report:

-Collaborative Environments
-Online Communication Tools
-Mobiles
-Cloud Computing
-Smart Objects
-The Personal Web

The technologies that are moving quickly into the mainstream are collaborative environments and online communication tools. Mobile devices for learning and the use of the cloud to store data and run applications also appear to offer schools greater, and perhaps more cost-effective, options for 1:1

learning They also provide access to learning resources and applications whether at home, school, or traveling.

From an infrastructure perspective, mobile devices increase support responsibilities for already understaffed technology departments at schools. A significant issue to be considered in the deployment of mobile devices or 1:1 projects is sustained funding for both technology support and professional development. Cloud computing, on the other hand, offers the potential promise of offloading hardware and technical support for data storage and some applications, while increasing access to students, teachers, and administrators. However security concerns are one potential drawback to the expansion of data and applications into the clouds.

Supporting these collaborative tools, increased use of digital curriculum, and anytime access to a learning environment means ensuring every student has access to a computer or other digital learning device. Currently Arizona has an average student to computer ratio of between three or four students for every computer. This ratio has increased considerably from the 2000 Arizona School Facilities Board (SFB) initial standard of eight students for every computer. The increased use of learning management systems, personalized learning opportunities, and the embedding of digital learning activities has required schools to ensure that more students have access to computers on a regular basis than was possible with a standard of 8:1. Businesses would find it hard to imagine an effective working environment, in which three or four employees are expected to share one computer, and one computer for eight employees is inconceivable, but this is the reality for Arizonaâ€™s students today.

The data also shows that, in order to increase the student-to-computer ratio from 8:1 to just over 3:1, schools have had to maintain computers for much longer than is recommended. The data shows that:

-Over 25% of districts indicated that their computers are all 3 years or older.
-20% of districts indicated that their computers are all 5 years or older.
-All but 38 districts reported that at least some of their computers were 5 years or older.
-The lower the bandwidth capacity reported, the older the computers being maintained.
- Low bandwidth was reported across the state in both rural and urban locations.
Taken from 2008-2009 ADE Educational Technology Survey

Conclusion

Maintaining aging technology significantly increases support costs for schools in both time and money in an area that is already widely underfunded and understaffed. The combination of increased support requirements and aging technology contributes to the frustration teachers and students feel about lacking the technology tools needed for todays learning environment, or their ability to use them

effectively. To combat these challenges, schools are attempting a variety of strategies, including exploring the use of low-cost thin client computers, net books, or lease arrangements. The recommendations below offer a series of strategies that will maximize the infrastructure necessary to support a robust learning environment. This environment, supported by a dedicated, adequate funding stream, will allow all schools to provide the required support and hardware to use technology effectively in todayâ€™s classrooms.

Recommendations to State Leadership

1. Develop a multi-agency effort in cooperation with the appropriate public and private sector entities including the Arizona Telecommunications and Information Council (ATIC) and Government Information and Telecommunications Agency (GITA), to enhance statewide high-speed broadband access to the Internet with sufficient broadband capacity and capability to support a digital learning environment.
2. Develop a statewide high-speed network that provides all PreK-12 schools and districts with access to up to at least 100 Mbps Internet bandwidth per 1,000 student/staff. (Adapted from High-Speed Broadband Access for All Kids)
3. Create sustainable long-term financing to ensure that all Arizona schools have equitable access to hardware and software that is refreshed on an industry-standard basis.
4. Create sustainable long-term financing to fund new school construction and retrofitting of existing schools to create a technology infrastructure necessary to support a digital learning environment.
5. Create sustainable long-term funding to provide a 1:1 learning environment for 6th-12th grade students and at least a 3:1 ratio for students below 6th grade. (ETAC has avoided using computer to student ratios because other digital learning devices, i.e. net books or smart phones, might describe these ratios)

Recommendations to the State Board of Education

1. Charge the State Department of Education with the development of a set of Recommended Standards of Technology-Based Resources for districts to set a baseline level of developmentally appropriate technology that supports standards for instructional systems (hardware, software, and infrastructure).
2. Charge the State Department of Education with the development of an Arizona Technology and Readiness Chart, similar to that developed by the CEO Forum STaR Charts to establish benchmarks for the use of developmentally appropriate technology to promote student learning.

Recommendations to the Arizona State Department of Education

1. Work with agencies and organizations to create and disseminate a Recommended Standard of Technology-Based Resources to set a baseline level of developmentally appropriate technology that supports anytime/anywhere access to an environmentally safe digital learning environment (hardware, software, and infrastructure) for all students.

2. Work with agencies and organizations to create and disseminate an Arizona Technology and Readiness Chart, similar to that developed by the CEO Forum STaR Chart to establish benchmarks for the use of developmentally appropriate technology that promotes student learning.
3. Develop and disseminate models of long-range educational technology planning that are consistent with federal regulations such as the NCLB Title IID and E-Rate programs.
4. Develop and maintain a common standard for the storage of student data that is safe, secure, and recoverable.
5. Participate in the collaboration between public and private entities to provide anytime/anywhere equitable access to robust broadband network resources for all students, educators and parents.
6. Collaborate with private entities (including non-profits such as AzTEA) to develop face-to-face and online opportunities for support staff from districts with common size, interests, and technologies to meet and share best practices in infrastructure support.
7. Work with LEAs, higher education, the private sector, and organizations such as the State Educational Technology Directors Association and the Consortium for School Networking to develop a methodology to determine Value on Investment (VOI) for technology expenditures.

Recommendations to Local Education Agencies
1. Annually review the Recommended Standards of Technology-Based Resources provided by the Arizona Department of Education for district alignment with these standards and work to bring district technology to at least these recommended levels by retrofitting existing facilities and, where possible, build the capacity to adapt to new technologies.
2. When constructing new school facilities, insure that these facilities meet at least the Recommended Standards of Technology-Based Resources and, where possible, build the capacity to adapt to new technologies.
3. Review, develop, and implement strategies to move all educators within the LEA to at least the Target level of technology use on the Arizona Technology and Readiness Chart.
4. Develop and implement new strategies and practices for the funding, purchase and support of technology infrastructure and services.
5. Provide a 1:1 learning environment for 6th-12th grade students and at least a 3:1 ratio for students below 6th grade. (ETAC has avoided using computer to student ratios because other digital learning devices, i.e. net books or smart phones, might describe these ratios)
6. Maintain a connection to the statewide broadband network to connect the LEA to the Internet. (Adapted from High-Speed Broadband Access for All Kids)
7. Maintain an internal wide area network that provides connections from the district to each school and between schools of at least 100 Mbps per 1,000 students/staff within the next one to four years and at least 1 Gbps per 1,000 students/staff within the next five to seven years. (Adapted from High-Speed Broadband Access for All Kids)
8. Provide and maintain an infrastructure for communications with parents and community members, including year-round anytime/anywhere access to school news, educational resources, and data.

9. Utilize technologies that are environmentally safe and can be used to ensure the safety of students (i.e. surveillance and emergency warning systems).
10. Provide and maintain an infrastructure for online grading and assessment systems that are standards based and allow access to student performance data to students, parents, and appropriate district personnel.
11. Develop strategies, resources, and best practices that facilitate anytime/anywhere access to digital learning resources and activities by all students within the district. This includes secure access to network resources and ensuring that critical technology applications and data can be recovered in a timely manner.
12. Provide funding and release time for support staff from districts of common size, interests, and technologies to meet and share best practices in infrastructure support.

Recommendations to Higher Education
Initial Teacher Preparation and Educational Leadership Programs
1. Acquire and maintain current technology for educator preparation facilities.
2. Establish infrastructure partnerships with Local Education Agencies for anytime/anywhere content delivery and professional development.

Higher Education in General
1. Partner with the Department of Education, the private sector, and Local Education Agencies to design and implement an accessible high-speed internet with access to national and international resources.
2. Partner with the research community to develop technologies that are 1) environmentally safe and 2) can be utilized to ensure the safety of students (i.e. surveillance and emergency warning systems).

Recommendations to the Community
School Boards
1. When constructing new school facilities, insure that these facilities meet at least the Recommended Standards of Technology-Based Resources and, where possible, build the capacity to adapt to new technologies.
2. Review, develop, and implement strategies to move all educators within the LEA to at least the Target level of technology use on the Arizona Technology and Readiness Chart.
3. Develop and implement new business strategies and practices for the purchase and support of the technology infrastructure and services.
4. Review, develop, and implement strategies to move to at least the Target level of technology use on the Arizona Technology and Readiness Chart.

Parents
1. Provide students with access to high-speed Internet connectivity either at home or through a

community resource.
2. Provide students with access to a computing device capable of supporting access to the Internet and district software either at home or through a community resource.
3. Support anytime/anywhere access to personal computing devices and to existing and emerging networks for communication with schools and community learning facilities.
4. Advocate to the State Legislature to provide funding to support high-speed Internet connectivity to all schools in Arizona.
5. Advocate to the State Legislature to provide funding to support the technology infrastructure necessary to support student learning in all schools in Arizona.

Professional Organizations
1. Develop face-to-face and online opportunities for support staff from districts with common size, interests, and technologies to meet and share best practices in infrastructure support.
2. Share best practices from education, business, and industry to support school infrastructures and develop ways for schools to utilize statewide infrastructures currently being developed by cities, state agencies, health institutions, private enterprise, and Higher Education.

Private Sector
1. Advocate to the State Legislature to provide funding to support high-speed Internet connectivity to all schools in Arizona.
2. Advocate to the State Legislature to provide funding to support the technology infrastructure necessary to support student learning in all schools in Arizona.
3. Develop strategic partnerships with communities to provide anytime/anywhere accessible wireless networks and computing devices available for all citizens.
4. Participate in partnerships with public and private entities to aggregate demand and lower cost for broadband access for schools, businesses, government, and consumers.
5. Share strategies and best practices for security audits and business continuity planning that can be conducted at the district and local school level.
6. Develop strategic partnerships with local education agencies to foster infrastructure support, including promotion of interoperability and accessibility, the use of commercial software, and the use of open-source software and web-based services.
7. Develop software applications that meet interoperability, accessibility, and usability standards, assist schools in data-driven decision-making, and enable anytime/anywhere parental access.
8. Develop low-cost, standardized, accessible, scalable, personal computing devices and services for PreK-12 students to support educational objectives and enable anytime/anywhere 1:1 computing.
9. Establish grant programs in support of local technology use in schools.
10. Participate in consortiums to allow group purchases of high-ticket hardware, software, and networking resources.